1-2015

NRGY 243.50: Fundamentals of Photovoltaic Design and Installation - Online

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MISSOULA COLLEGE
UNIVERSITY OF MONTANA
DEPARTMENT OF APPLIED COMPUTING AND ENGINEERING TECHNOLOGY
ENERGY TECHNOLOGY PROGRAM

NRGY 243: Fundamentals of Photovoltaic Design and Installation
Course Syllabus
Spring 2015

Instructor: Conor Darby
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Credits: 3
Final: NABCEP Certificate of Knowledge Exam to be taken during finals week

Course Description
This course is an introduction to the fundamental principles and technologies of solar photovoltaic energy systems. Emphasis on system design and installation including site and resource assessment, load analysis, system component selection, and system operation, maintenance, and trouble shooting. The material covered prepares students for a career in renewable energy or for installing a renewable energy system on their own home.

Prerequisites
ETEC 105 (EET 105, EET 111) DC Circuit Analysis
M121 College Algebra (or equivalent)

Course Learning Objectives
A student who has met the objectives of this course will be able to:
• Describe the history and current applications of solar photovoltaic (PV) technolgies
• Correctly use basic electrical and solar terminology
• Describe the major components of a PV system
• Describe factors that affect solar output
• Estimate PV system output and cost
• Perform a residential electrical load analysis
• Perform a residential solar resource site analysis using a Solar Pathfinder™ or equivalent technology
• Describe tools of the trade and safe working practices
• Use a digital multi-meter and insolation meter for PV applications
• Draw plan view and of site electrical diagrams for PV installation
• Acquire basic knowledge of and ability to reference the US NEC (National Electric Code)
• Describe NABCEP (North American Board of Certified Energy Practitioners) and take NABCEP Certificate of Knowledge Exam (Students may take exam up to four times without repeating course)

You are encouraged to contact the instructor with questions and for consultations throughout the semester. There is also a thread in the discussion section on the course website for questions - feel free to post or answer questions there.

Course Text (Required)
Photovoltaic Systems, Third Edition
James P. Dunlop, American Technical Publishers.
ISBN: 978-1-935941-05-7
Available at the U of M Bookstore or online.
(Note that the textbook supplemental CD requires Windows operating system and will not be required for the course.)

NABCEP Exam Registration (Required)
Purchase registration through bookstore.

Other Course Materials (Required)
• Digital multimeter for measuring AC and DC voltage and resistance. Inexpensive meters ($25) are available from Radio Shack, Sears, auto parts stores, or online.
• Kill-A-Watt meter for measuring electricity consumption. Available online for $25-$35.
• Seaward Solar Survey 200R- records cell temperature, and individual module Voc and Isc (optional)

Grading
Assignments 20% Quizzes 20% Exams 30% Class Project 30%

Assignments, Quizzes and Exams
Each week students will spend 7-15 hours reading the textbook, completing assignments, quizzes, and exams. Assignments, quizzes, and exams are to be completed by the date and time noted in each case; many are time limited so prepare and plan accordingly. **Late work will be penalized.**

Class Project
The class project requires a site visit, complete system design, and report. The elements of the project correspond closely with many of the topics we will cover. I highly recommend reviewing the project requirements early and completing each section as we cover the material.

Final Exam
The NABCEP Entry Level Exam will be administered at the completion of the course and will serve as the final. You can register for the exam through the bookstore when you buy your book. Students who will not be able to take the test in person should contact me directly to make special arrangements.

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TOPIC OUTLINE AND SCHEDULE FOR NRGY 243

Week 1 Intro to Photovoltaic Systems (Jan26th)
- Photovoltaics
- PV Applications
- Solar Energy Technologies

Week 2 Solar Radiation (Feb 2nd)
- Solar Radiation
- Sun-Earth Relationships
- Array Orientation
- Solar Radiation Data Sets

Week 3 Site Surveys and Preplanning (Feb 9th)
- Preliminary Assessment
- Site Surveys
- Preparing Proposals
- Installation Planning

Week 4 Components & Configuration (Feb 16th)
- Components
- Electricity Sources
- System Configuration

Week 5 Cells, Modules & Arrays (Feb 23rd)
- Photovoltaic Cells
- Current-Voltage (I-V) Curve
- Device Response
- Modules and Arrays

Week 6 Batteries (Mar 2nd)
- Principles
- Types
- Systems

Week 7 Charge Controllers (Mar 9th)
- Types
- Features & Setpoints
- Applications

Week 8 Inverters (Mar 16th)
- AC Power
- Inverters
- Inverter/Chargers
- Inverter Features and Specifications

Week 9 System Sizing (Mar 23rd)
- Methods
- Calculations

Spring Break (March 30th)

Week 10 Mechanical Integration (Apr 6th)
- Considerations
- Mounting Configurations
- Integration

Week 11 Electrical Integration (Apr 13th)
- Integration
- Conductors and Wiring Methods
- Overcurrent Protection
- Disconnects
- Grounding
- Battery Systems

Week 12 Utility Interconnection, Permitting & Inspection (Apr 20th)
- Interactive Distributed Generation
- Utility Interconnection Policies
- Building Codes and Regulations
- Permitting
- Inspection

Week 13 Commissioning, Maintenance & Troubleshooting (Apr 27th)
- Commissioning
- Maintenance
- Monitoring
- Troubleshooting

Week 14 Economic Analysis (May 4th)
- Politics
- Incentives
- Class Project Due

Week 15 Finals (May 11th)
- NABCEP Entry Level Exam